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ABSTRACT

A continuation of the field test of Developing Mathematical Processes (DMP) was conducted in eight schools. Four were multiunit schools located in settings ranging from small town to large city; the remaining schools were conventionally organized and located in large urban areas. The purpose of the field test was (1) to determine the effectiveness of the instructional program in terms of student achievement, and (2) to document the usability of the program. The field test focused on the third level of the program. The results indicated a mastery level of approximately 81 percent on the specific objectives of the program. Overall performance was retarded by poor results in one topic. On the latter portions of the program, maintenance of the mastery level reached a level of 83 percent. The data on standardized test achievement did not conclusively favor either DMP or its conventional counterparts. The field test established that (1) teachers will expend the effort to attend frequent inservice meetings, to prepare instructional materials, and to plan for the several instructional modes in the program; and (2) students will enthusiantically participate in the learning activities. On the basis of the data gathered in the field test, DMP was demonstrated to be a viable program for second-grade children. (Author/SD)

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Technical Report No. 324

DEVELOPING MATHEMATICAL PROCESSES: 1972-73 FIELD TEST REPORT

by

W. Donald Hubbard and Anne E. Buchanan

Report from the Technical Services Section

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Wisconsin Research and Development
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WISCONSIN RESEARCH AND DEVELOPMENT CENTER FOR COGNITIVE LEARNING

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The mission of the Wisconsin Research and Development Center for Cognitive Learning is to help learners develop as rapidly and effectively as possible their potential as human beings and as contributing members of society. The R&D Center is striving to fulfill this goal by

- conducting research to discover more about how children learn
- developing improved instructional strategies, processes and materials for school administrators, teachers, and children, and
- offering assistance to educators and citizens which will help transfer the outcomes of research and development into practice

PROGRAM

The activities of the Wisconsin R&D Center are organized around one unifying theme, Individually Guided Education.

FUNDING

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ABSTRACT

A continuation of the field test of Developing Mathematical Processes was conducted in eight schools. Four were multiunit schools located in settings ranging from small town to large city; the remaining schools were conventionally organized and located in large urban areas. The purpose of the field test was (a) to determine the effectiveness of the instructional program in terms of student achievement, and (b) to document the usability of the program. The second year of the field test focused on the third level of the program.

The results of the field test indicated a mastery level of approximately 81 percent on the specific objectives of the program. Overall performance was retarded by poor results in one topic. On the latter portions of the program maintenance of the mastery level reached a level of 83 percent. The data on standardized test achievement did not conclusively favor either DMP or its conventional counterparts. There was some evidence of lower achievement for DMP students in the nonurban multiunit schools. When the opportunity for a student to learn tested material was considered in the analysis, DMP students compared favorably to non-DMP students. Finally, in regard to the usability of the program, the field test established that teachers will expend the effort to attend frequent inservice meetings, to prepare an appreciable amount of instructional materials, and to plan for the several instructional modes in the program. In addition, it was determined that students will enthusiastically participate in the learning activities. On the basis of the data gathered in the field test, Developing Mathematical Processes was demonstrated to be a viable program for elementary school children at the second-grade level.

I

INTRODUCTION

This report describes the second year of a small-scale field test of Developing Mathematical Processes (DMP). The report on the first year of the field test (Hubbard, 1972) deals with implementation of the first two levels of the program with kindergartners and first graders. This report deals with the use of the third level with second graders in the same schools. Because the two years of the field test are similar, there is a body of descriptive material that pertains to both reports--it is included in both of them so that they may be read independently.

The field test described in this report is designated a small-scale field test. It is the fourth phase of a five-phase program development sequence utilized by the DMP project. The phases are: definition, analysis, pilot, small-scale field test, and large-scale field test. The latter three phases involve the use of the program with students and teachers for the purpose of testing the program's effectiveness and usability. The two field test phases frequently involve the same version of the program, but there are differences in the number and proximity of field test schools and in the degree of mediation in the program by the R & D Center staff. Reports for each of the phases are available from the R & D Center.

The version of the program used by the small-scale field test schools is designated the developmental version. It is a revision of the pilot version and antedates the commercial version. Although there is a basic likeness among the three versions, there are differences in format and in packaging as well as revisions based on the evidence gathered in each phase.

OVERVIEW

Developing Mathematical Processes is a research-based instructional program for K-6 elementary school children that is being developed at the Wisconsin Research and Development Center for Cognitive Learning of the University of Wisconsin. A complete description of the program is not practical for this report, but several important characteristics are noted. For a more complete description see the Resource Manual, Topics 1-40, (1974).

DMP utilizes an activity context for learning mathematics--a carefully sequenced program of activities that provides instruction for a set of well-defined behavioral objectives. A variety of activities suited to the age and interests of the students is presented to involve them in "doing" mathematics.

DMP approaches mathematics through measurement. Beginning with the objects in their own world, the students examine the attributes of these objects and explore the relationships between them through the use of various processes using pictorial and symbolic representations of the objects and their interrelationships as the next step toward abstract mathematics. This

is followed by modeling mathematical sentences with real objects. Thus the connection between abstract mathematics and the real world is continually emphasized in the measurement approach. This connection is further strengthened by the problem-solving situations that are used in the DMP materials.

DMP integrates the mathematical areas of arithmetic, geometry, probability, and statistics. This integration is a natural outgrowth of examining the relationships between objects and generating numerical data from real-world problems. DMP therefore includes the intuitive and informal geometry of size, shape, and relationships among two- and three-dimensional objects, and the elementary notions of probability and statistics that lead to the organization and analysis of data.

DMP provides an instructional management system to accommodate individual differences in students. In addition to the variety of activities to suit students' interests and learning styles, there are assessment materials that include observational procedures for using classroom activities to evaluate student progress and criterion-referenced tests for placement and evaluation. There are also sequencing suggestions that enable a teacher to select options for a student's progress through the program. This instructional management system is consistent with the more comprehensive system of educational programs called Individually Guided Education (Klausmeier, Quilling, Sorenson, Way, & Glasrud, 1971). The IGE system is designed for the individual student in such a way that planned variations are made in what the student learns, the rate at which he learns it, and the way he learns it.

DMP includes an inservice program to assist teachers in the implementation of the program. Since DMP cannot be successfully implemented in schools without careful consideration by every teacher of the distinctions that separate DMP from other mathematics programs, a systematic iterative inservice program has been developed and field tested. The inservice consists of a series of meetings using audiovisual materials and guides which describe the most effective teacher/learning environments and provide the background information necessary to implement the program. For more detailed information related to the implementation of DMP, see Working Paper No. 74 (Romberg, McLeod, & Montgomery, 1971). The inservice was field tested as a part of the first year of the small-scale field test. It is reported both in the field test report for the first year and in Technical Report No. 245 (McLeod).

GOALS AND OBJECTIVES OF DMP

Terminal Goals

The primary goal of DMP is that, upon completion of the program, students will be able to translate problems from the everyday world into mathematics, solve the problems mathematically, and translate the results back into the everyday world. This goal is based on the belief that the practical value of mathematics is in its application to reality. Students who are mathematically proficient are more than computers; they are problem solvers.

A second terminal goal is that, upon completion of the program, students will be able to examine mathematics, identify the structural properties and relationships in mathematics, and logically validate mathematical assertions. This goal can be reached only after students have had an opportunity to develop

considerable knowledge of mathematics. Only then can they begin to examine the characteristics of different systems and the properties of those systems.

Specific Objectives

Each topic of DMP contains a set of specific behavioral objectives. In the assessment of these objectives, conditions are established for three levels of performance: Mastery (M), Making Progress (P), and Needs Considerable Help (N). Upon completion of instruction in a given topic a student is expected to perform at either of the first two levels of mastery (M or P). For any given group completing a topic, 95 percent of the ratings of the students' performance are expected to be at the first two levels of mastery.

This criterion represents a change from the criterion used in the first year of the field test when collections of objectives were considered jointly as a way of estimating the students' overall performance for a complete year's work. This proved to be difficult to assess accurately. More importantly, the specification of a year's work was inconsistent with the assumptions of the IGE system related to the continuous progress of learning. Thus the criterion was changed to focus more specifically on the immediate outcomes of instruction.

The change in criterion does not mean that long-range evaluation or even intermediate-range evaluation is not of concern to the R & D Center staff. Specification of the terminal goals provides an appropriate context for assessing the long-range effects of the program. To provide for assessment of intermediate-range effects, accountability tests are being developed. In addition, teachers have been alerted to watch for students whose performance over the course of several topics does not show tendency toward mastery (M).

The change in criterion reflects two things: (1) that the primary concern at this stage of development is on the immediate effect of instruction, and (2) that the field test is not designed to assess the longitudinal performance of students in an IGE curriculum.

SEGMENTS OF THE DMP PROGRAM

The following three segments were developed for the field test version of the DMP program:

1. Instructional materials

   - The Teacher's Guide is the primary source of information and guidance for implementing the program. It is a detailed exposition of objectives, activities, instructional recommendations and supplemental suggestions. The teacher uses the guide extensively when implementing the program.

   - The materials kit contains the items of special manufacture that are essential to carrying out the instructional activities.

   - The printed materials package contains activity cards, pupil performance records, and other nonconsumable student materials.

   - Pupil workbooks contain printed sheets that each student can use, at the discretion of the teacher, for practice and exploration.

2. Assessment materials

- An assessment manual provides assistance for using the assessment instruments.
- Pupil test booklets contain placement inventories for making judgments about the initial grouping of students for instruction and topic inventories for assessing the students' mastery of the objectives.
- Pupil performance records (found in the printed materials package) provide teachers with a number of options for recording student achievement.
- Teacher Observation Procedures (contained in the Teacher's Guide) are a set of detailed instructions for assessing the students' attainment of objectives as they participate in classroom activities.

3. Inservice materials

- An Activity Approach to Math describes the teaching styles of the teacher and the learning styles of the student that the developers have found to be the most effective for implementation of the program.
- Assessment and Managing Instruction outlines a strategy that teachers can employ using DMP materials to adapt their instruction to the individual achievement levels of the students.
- DMP Sampler provides an overview of the program through the inclusion of sample pages from each of the instructional and assessment segments of the program.

REQUISITES FOR EFFECTIVE IMPLEMENTATION

The R & D Center staff considers the following conditions to be requisite for effective implementation of DMP by field test schools:

1. Attendance of the teaching staff (attendance of principals is optional but desirable) at an inservice meeting sponsored by the developer and held prior to implementation of the program
2. Instruction in DMP for at least $2\frac{1}{2}$ hours per week for students in their third year of school
3. Participation of the teaching staff in conferences and consultations with the inservice coordinator under mutually convenient arrangements
4. Demonstration of a teaching style that includes the following components:
   a. providing materials for activities
   b. opening activities by posing problems or demonstrating an activity

c. grouping students for effective instruction according to recommendations in the Teacher's Guide

d. moving from group to group and serving as a resource to particular needs

e. conducting discussions for summarizing and extending ideas of an activity

5. Attention to the assessment procedures and classroom management guidelines, which include:

a. use of an observational/pupil-performance-record procedure to assess students' progress

b. use of topic inventories to substantiate teacher judgment and, in conjunction with the placement inventories, to determine the mastery levels of students

c. selection of activities for instruction in regard to the appropriateness to a given objective and the existing distribution of student performance levels

d. formation of instructional groups based upon judgments of each student's mastery level and learning style

6. Attendance of the teaching staff (attendance of principals is optional but desirable) at a midyear inservice meeting sponsored by the developer

OBJECTIVES OF THE FIELD TEST

The principal objective of a field test is to determine whether the program meets its own objectives when installed and implemented according to plan. In addition a field test may have objectives which extend the design and instrumentation beyond that required to evaluate the program objectives.

For the DMP field test three additional objectives were specified. Two of these involved student performance on standardized tests and the maintenance of mastery levels of specific objectives. The third objective focused on implementation considerations--those aspects of any program of concern to school personnel when adoption of the program is contemplated--cost, staff responsibilities, time allocation, and usability of materials.

The objectives of the field test were as follows:

1. To determine whether the objectives of the program (described above) are met

2. To compare the achievement of students using DMP to students not using DMP as measured by norm-referenced, standardized measures and by criterion-referenced, DMP achievement measures

3. To determine the maintenance of the students' achievement on DMP objectives previously mastered

4. To document four aspects of DMP implementation

   a. cost

   b. staff responsibilities

   c. time allocation

   d. usability of materials

II

METHOD

SUBJECTS

The eight schools that participated in the first year of the field test also participated in the second year. Four of the schools were located in central city areas and were organized conventionally into self-contained classrooms. The other four schools utilized the multiunit pattern of school organization. One of the multiunit schools was in an urban but noncentral-city area, while the remaining three schools were in settings that ranged from small town to medium-sized city. Central city and multiunit schools were chosen because of the Center's particular interest in determining the program's effectiveness in these settings.

The students who used DMP during the first year of the field test continued to use it during the second year. Of particular interest were those students in their third year of school (Grade 2). In the four central city schools, students in the third grade also used DMP but at the same level as the other participating students. In the three Chicago schools the third grade students were new to DMP, but the Milwaukee school had used DMP with its second graders during 1971-72. As shown in Table 1, approximately 1,000 children and 33 teachers were included in the field test.

The field test teachers in almost all cases were new to DMP. In spring 1972 most of them attended meetings of approximately two-hours duration at which DMP and the field test were described. A memorandum of agreement (Appendix A) was discussed with the teachers and subsequently signed by the appropriate administrator.

INSTRUMENTATION

Specific instruments are associated with each objective of the field test.

Objective 1

The terminal goals of the program will be assessed by instruments to be developed for administration in later stages of the field test. These instruments will be designed to structure situations in which the student can demonstrate his ability to perform tasks that indicate attainment of the terminal goals.

Specific program objectives were assessed by using the topic inventories, which are criterion-referenced instruments. Some specific objectives, however, could be assessed only by teacher observations; these observations were recorded in the pupil performance records but not used for this objective.

TABLE 1

DESCRIPTION OF SCHOOLS AND PARTICIPANTS

School and City	Description	Organization	Grade 2 Classes	Grade 2 Teachers	Grade 3 Classes	Grade 3 Teachers
Willard, Chicago	central city	conventional	5	5	4	4
Parkman, Chicago	central city	conventional	3*	3	1	1
Hamline, Chicago	central city	conventional	3*	3	2	2
Fourth Street, Milwaukee	central city	conventional	1	1	1	1
		Subtotal	12	12	8	8
Victory, Milwaukee	urban, noncentral	MUS	4	4	--	--
Morgan Martin, Green Bay	medium-sized city	MUS	4	4	--	--
Lawrence Lawson, Sparta	small city	MUS	2	2	--	--
Galesville	small town	MUS	3	3	--	--
		Subtotal	13	13	--	--
		Total	25	25	8	8

*Includes one combination Grade 2/Grade 3.

Objective 2

The achievements of students who have used DMP and those who have not used DMP were assessed by standardized measures, and these results were compared. The arithmetic sections of the California Achievement Test (Forms 1A and 1B) and the Cooperative Primary Test (Forms 23A and 23B) were selected as most closely reflecting the content of DMP for Grade 2 students. The appropriate forms of the same instruments will also be used for Grade 3 students. In subsequent years of the field test the mathematical subtests of the Iowa Test of Basic Skills will be used at the upper grade levels. Accountability instruments are being developed by the project staff. They will be used to assess the students' overall achievement in such areas as computation, problem solving, and understanding of mathematical concepts. Norms from several populations will be established for the instruments, but they will emphasize the content, notation, and sequence of development used in DMP. These instruments were not available for this field test.

Objective 3

After a period of time had elapsed following instruction on an objective, the topic inventories were used to assess the mastery level of students on that specific program objective.

Objective 4

Data concerning the implementation of the program were gathered from questionnaires and interview schedules developed by the R & D Center evaluation staff for the purposes deemed important at the time of a monitoring visit.

TESTING AND MONITORING SEQUENCE

In a small-scale field test there is need for comprehensive information regarding the field test objectives. This need is offset, however, by the desire to minimize disruption of classroom programs and to allow the unencumbered implementation of the program. In order to strike a balance between the need for information and the desire to minimize disruption, a stratified random sampling procedure was used to gather data on all the field test objectives except the one dealing with standardized testing.

Three monitoring visits were conducted between November 1972 and May 1973. Schools were randomly selected from each of the two school categories: conventionally organized, urban; and multiunit, nonurban. The selection proportion was .5 and there was replacement of the selected schools. Interviews for gathering implementation data were conducted with the people most likely to provide the information. One class for providing data about the mastery level on specific program objectives was randomly selected from all the eligible classes and another class was randomly selected to provide data about the maintenance of the mastery level of the specific program objectives. Six students in the selected classes were randomly chosen to be tested on the appropriate inventory.

Topic inventories were chosen on the basis of the progress of the class in the program. For assessing the mastery level of the students, the topic inventory for the last completed topic was used. For assessing the maintenance of the mastery level, the topic inventory for the next to last completed topic

was used. If the topic inventory selected for assessing mastery after instruction had been given already, it was not given again. Instead the data used were copied from the teacher's records.

Data on maintenance of the mastery levels were gathered in only the last two monitoring visits. The progress through the second grade materials did not allow the proper amount of instruction to occur for assessing this field test objective in the first monitoring visit.

To compare achievement of students using DMP with students not using DMP, as measured on standardized tests, baseline data were gathered in the field test schools in the spring of 1972 from second-grade students who had used the schools' regular mathematics programs. In the spring of 1973 the second-grade students who had used DMP completed different forms of the same test. This comparison assumes that the two successive sets of second-grade students are similar on all pertinent matters except the use of DMP. In addition, no direct comparison can be made between specific mathematics programs and DMP. Given the level of development of DMP, however, no more sophisticated comparisons are warranted.

Table 2 contains a summary of the data-gathering information.

TABLE 2

SUMMARY OF DATA-GATHERING INFORMATION

Objective	Instrumentation	Testing Schedule	Primary Analysis
1. Mastery of DMP program objectives			
a. terminal	To be developed		
b. specific	Topic inventories	Three monitoring visits between November 1972 and May 1973	Proportion of students meeting program criterion
2. Comparisons to students who do not use DMP	Forms 1A and 1B of California Achievement Test (1970); Forms 23A and 23B of Cooperative Primary Test (1965); DMP Accountability Tests to be developed	Baseline data, spring 1972; Comparative data, spring 1973	Comparison of means
3. Maintenance of student mastery	Topic inventories	Two monitoring visits between January 1973 and May 1973	Proportion of students meeting program criterion
4. Implementation aspects	Questionnaire, interview schedule	Three monitoring visits between November 1972 and May 1973	Descriptive data

III

RESULTS AND DISCUSSION

As indicated in Table 2, the field test provided data for the four field test objectives: determining student mastery on specific program objectives, comparing the achievement of DMP and non-DMP students on standardized tests, determining the maintenance of student mastery on specific objectives, and documenting various aspects of implementation.

STUDENT MASTERY ON SPECIFIC OBJECTIVES

As each student completes a topic, it is expected that he will either master the objectives of that topic or be making progress toward the mastery of them. It is expected that 95 percent of the students in any given group will meet this criterion. The topic inventories provide the conditions by which a teacher can evaluate the students' level of mastery. R & D Center staff used these inventories on randomly selected students to determine the effectiveness of the program in terms of student mastery of specific objectives.

In the first year of the field test the classes completed only about 70 percent of the material that was intended for their grade level. Thus, in the second year of the field test some time was devoted to completing the material originally intended for the first year. In addition, the first topic in the second year material contains instruction that is utilized in subsequent parts of the program and is not assessed until then. Therefore, the objectives of only three topics were assessed in the course of the second year field test. These three topics span seven of seventeen topics considered "usual" for the students. In the end-of-year report from all of the field test schools, the average yearly progress through the program was seven and one-half topics for nonurban schools and four topics for urban schools. Table 3 contains the percents of ratings of student performance that were either Mastery (M) or Making Progress (P) on the objectives in the three topics with assessed objectives.

The percentages reported in Table 3 are below the expected figures, particularly in the topic dealing with equalizing situations. It is encouraging to note that in the nonurban schools the percentages in the number sentences topic are much higher than those in the first topic. These two topics are closely related and the increased percentages indicate a cumulative learning effect.

Table 4 contains the percents of each type of rating for the specific objectives of the three topics. The figures in Table 3 and Table 4 are directly comparable because the mastery criterion reported in Table 3 considers combinations of Mastery (M) and Making Progress (P) ratings. The percentages in Table 4 are included here to indicate any shift in the proportion of M and P ratings. In the two related topics mentioned previously (equalizing situations and number sentences), not only did the percent of nonurban students meeting the Mastery criterion increase (see Table 3) but the percent of M ratings overall increased even more dramatically.

TABLE 3

MEAN PERCENT OF M OR P RATINGS* OF STUDENT PERFORMANCE AFTER INSTRUCTION ON THE OBJECTIVES OF THREE TOPICS

School Type	Topic						Weighted Mean
	Representing Other Equalizing Situations		Grouping		Number Sentences		
	Obj 2	Obj 3	Obj 1	Obj 2	Obj 1	Obj 3	
Urban	67	50	100	100			80
Nonurban	75	58	100	83	85	92	82
Mean of Means	71	54	100	92	85	92	81

* M = Mastery, P = Making Progress.

TABLE 4

MEAN PERCENT OF EACH TYPE OF RATING* OF STUDENT PERFORMANCE AFTER INSTRUCTION ON THE OBJECTIVES OF THREE TOPICS

School Type		Topic						Total
		Representing Other Equalizing Situations		Grouping		Number Sentences		
		Obj 2	Obj 3	Obj 1	Obj 2	Obj 1	Obj 3	
Urban	M	0	0	83	83			42
	P	67	50	17	17			38
	N	33	50	0	0			21
Nonurban	M	0	8	92	75	62	69	51
	P	75	50	8	8	23	23	31
	N	25	42	0	17	15	8	18
Mean of Means	M	0	4	88	79	62	69	46
	P	71	50	12	13	23	23	34
	N	29	46	0	8	15	8	20

* Mastery (M), Making Progress (P), Needs Considerable Help (N)

To summarize the data related to the students' mastery of specific objectives, the overall percentage of students meeting the criterion was lower than that expected. In two of the three topics tested (grouping and number sentences), the percentages were reasonably close to the expected figure. Two other results were encouraging: (1) The mastery data for the second of two closely related topics is considerably more positive than the data for the first topic, which indicates a cumulative effect. (2) There was evidence that urban and nonurban students are attaining similar mastery levels for the same topics. Urban students did not progress as quickly through the program, but they attained essentially the same levels of mastery.

COMPARISON OF DMP STUDENTS WITH NON-DMP STUDENTS

The second field test objective is to compare the achievement of DMP and non-DMP students on standardized tests. The mathematics subtests of the California Achievement Test and the Cooperative Primary Test were used to assess student achievement. In May 1972, baseline data were gathered for second-grade students in field test schools who had not participated in the program. In May 1973, the alternate forms of the same tests were given to students who had been using the program for two years but who had used conventional programs as kindergarteners. The above procedure does not account for students who transferred into the schools during the field test. Schools with a high turnover in student populations will have many students who do not have as much experience with DMP as those in other field test schools.

Table 5 contains comparative data on the two administrations of the standardized tests. The data are reported as percentiles in order to facilitate comparison of the results. The percentiles were derived from the means of the school raw scores means.

As the data in Table 5 demonstrate, the DMP students in nonurban field test schools generally show lower achievement levels than comparable non-DMP students. For students in urban schools, two of the four comparisons favor the DMP students. These results are not entirely surprising nor discouraging, for DMP is designed to develop conventional arithmetic skills only after a careful development of the conceptual basis for the skills. A consequence of this design is that mastery of some arithmetic skills in DMP instruction is expected at a later date than in other mathematics programs. Standardized tests typically reflect the instructional pace of conventional mathematics programs, putting DMP students at a disadvantage. This disadvantage was compounded by the relatively slow progress of the field test students through the program. Therefore, the differences between the scores of DMP students and the comparable non-DMP students are well within acceptable limits. It is anticipated that the differences will vanish, and in fact reverse themselves to the advantage of DMP students, in the latter stages of the program.

A more sensitive analysis of the standardized tests can be accomplished by considering only those items that are related to DMP instruction as recommended by Romberg and Montgomery (1971). Each item was inspected for its appropriateness to specific objectives in the program. Those items that can be equated with specific objectives were analyzed to determine the program's efficiency in terms of the student's learning, given his opportunity to learn. For example, students who have progressed to a given point in the program can be expected to answer correctly all items that have been equated with objectives

TABLE 5

PERCENTILE EQUIVALENTS OF MEAN RAW SCORES FOR TWO ADMINISTRATIONS OF THE MATHEMATICS SUBTESTS OF TWO STANDARDIZED ACHIEVEMENT TESTS

	School Type			
	Urban		Nonurban	
Subtest	May 1972	May 1973	May 1972	May 1973
California Achievement Test	Form 1B	Form 1A	Form 1B	Form 1A
Computation	20	18	65	29
Concepts & Problems	23	35	75	54
Total Mathematics	20	24	76	42
Cooperative Primary Test	Form 23B	Form 23A	Form 23B	Form 23A
Mathematics	22	16	66	61

contained in the program to that point. The degree to which that expectation is met is the degree of efficiency of the program.

This procedure developed out of the analysis of the data collected for the International Study of Educational Achievement (Husin, 1967). As applied to the DMP field test data, the procedure yields a fair comparative assessment of the effectiveness of DMP.

In equating the test items to the DMP objectives, two levels of similarity were noted: (1) some items were stated in such a way that a student who masters the DMP objective is expected to answer the item correctly; and (2) some items were stated in such a way that the item content is similar to a DMP objective but not similar enough to expect the student to answer the item correctly. In addition, some items were found for which no DMP objective could be equated.

Another factor to be considered in calculating the efficiency ratios was the progress of the students through the program. Only those equated items for which there had been instruction could be included in the analysis. Therefore, in addition to the two categories for the two levels of item similarity, and the one category for those items not related to a DMP objective, there was a set of items that were similar to DMP objectives but could not be included in the calculation of efficiency ratios because the instruction had not progressed far enough to include the equated DMP objectives. Table 6 contains the proportions of items in each category.

The data in Table 6 show that the field test schools had progressed to the point where as much as 55 percent of the items were related to the instruction (for nonurban students on the California Achievement Test) and as few as 19 percent of them were related (for urban students on the Cooperative Primary Test). If the field test schools had progressed at a rate near the one expected by the developers, more than 45 percent of items in the Cooperative Primary Test and 80 percent of those in the California Achievement Test would have

TABLE 6

MEAN PROPORTIONS OF EACH OF FOUR SUBSETS OF ITEMS FOR TWO ACHIEVEMENT TESTS GIVEN TO DMP STUDENTS IN TWO TYPES OF SCHOOLS

School Type/Test	Number of Items	Item Subset			
		Equal	Content Similar	Beyond Progress	Unrelated
Urban					
California Achievement Test	87	.13	.07	.80	.00
Cooperative Primary Test	60	.07	.12	.73	.08
Nonurban					
California Achievement Test	87	.46	.09	.40	.05
Cooperative Primary Test	60	.12	.20	.60	.08
Overall					
California Achievement Test	87	.30	.08	.60	.02
Cooperative Primary Test	60	.09	.16	.67	.08

been related. When the students complete the program, over 90 percent of the items will be related to the content of DMP.

The efficiency ratios for each of the related-item subsets are shown in Table 7.

A column of comparative ratios is included to assist in the interpretation of the efficiency ratios. The comparative ratios reflect the proportion of correct items that are needed for a student to attain the 50th percentile of a given test. The data clearly show that the field test students are answering the items correctly at the appropriate level when the progress of the instruction is considered. An exception to this is the urban students on the content-similar items. Although the content of each of these items was similar to a DMP objective, the similarity was not strong enough to assume a correct response from students who had mastered the objective. The urban students did not perform as well on items from this category as they did on items where the relationship between the item and the objective is more exact.

In order to set another context for interpreting the efficiency ratios presented in Table 7, a similar analysis was performed on the baseline data gathered in May 1972 from students not using DMP. Strictly speaking, this analysis did not yield efficiency ratios because the developers of the mathematics programs used by non-DMP students did not equate the test items with their instructional objectives. Instead, the test items were related to DMP objectives as in the previous analysis. The resulting ratios indicated the degree to which students who do not use DMP were able to learn material covered by DMP. Not all of the DMP objectives were considered in this analysis nor in the first one. Only those DMP objectives that are related to test items were considered.

TABLE 7

EFFICIENCY RATIOS FOR TWO SUBSETS OF RELATED ITEMS
ON TWO ACHIEVEMENT TESTS TAKEN BY DMP STUDENTS
IN TWO TYPES OF SCHOOLS
(MAY 1973)

School Type/Test	N Items	Equal	N Items	Content Similar	N Items	Total	Comparative
Urban							
California Achievement	11	.883	6	.665	17	.806	.805
Cooperative Primary	4	.506	7	.466	11	.481	.500
Nonurban							
California Achievement	40	.908	8	.925	48	.911	.897
Cooperative Primary	7	.685	12	.638	19	.655	.500
Overall*							
California Achievement		.896		.795		.859	.851
Cooperative Primary		.596		.552		.557	.500

* Unweighted mean.

The comparative ratios presented in Table 8 were calculated in the same manner as the efficiency ratios presented in Table 7. The items were categorized according to their similarity to DMP objectives. The same progress through DMP was assumed when determining which items to include in the analysis.

The ratios in the two tables are remarkably similar. At Grade 2, DMP and the mathematics programs used previously in the field test schools are about equally effective in their instruction on items selected for their similarity in content to DMP objectives.

The efficiency ratios for the two remaining categories of items are reported in Table 9 to denote the decline in the students' achievement levels. It is interesting to note, however, that the students attained the 50th percentile on the unrelated items of the Cooperative Primary Test. Apparently students can adequately learn this material outside of DMP instruction.

Table 10 contains the comparative ratios for the last two subsets of items taken from the baseline data of students not using DMP. These ratios show the areas in which the nonurban baseline students outperformed the DMP students.

To summarize the results of the comparison of students' achievement on standardized tests, there is no conclusive evidence that favors either DMP or those programs that the field test schools used previously. The scores on the California Achievement Test for nonurban students appreciably favored the conventional programs. This was not the case for urban students on that test. Scores on the Cooperative Primary Test for both school types only mildly

TABLE 8

COMPARATIVE RATIOS FOR TWO SUBSETS OF RELATED ITEMS
OF TWO ACHIEVEMENT TESTS GIVEN TO STUDENTS NOT USING DMP
IN TWO SCHOOL TYPES
(MAY 1972)

School Type/Test	N Items	Equal	N Items	Similar	N Items	Total	Comparative
Urban							
California Achievement	11	.880	6	.609	17	.784	.805
Cooperative Primary	4	.404	7	.583	11	.518	.500
Nonurban							
California Achievement	35	.944	9	.850	44	.925	.805
Cooperative Primary	7	.668	9	.705	16	.689	.500
Overall*							
California Achievement		.912		.729		.854	.805
Cooperative Primary		.536		.644		.604	.500

* Unweighted means.

TABLE 9

EFFICIENCY RATIOS FOR TWO SUBSETS OF UNRELATED ITEMS
OF TWO ACHIEVEMENT TESTS GIVEN TO DMP STUDENTS
IN TWO SCHOOL TYPES
(MAY 1973)

School Type/Test	N Items	Beyond Progress	N Items	Unrelated	N Items	Total	Comparative
Urban							
California Achievement	70	.521			70	.521	.805
Cooperative Primary	44	.349	5	.496	49	.364	.500
Nonurban							
California Achievement	35	.797	4	.695	39	.787	.897
Cooperative Primary	36	.519	5	.513	41	.518	.500
Overall*							
California Achievement		.659		.695		.654	.851
Cooperative Primary		.434		.504		.441	.500

* Unweighted means.

TABLE 10

COMPARATIVE RATIOS FOR TWO SUBSETS OF UNRELATED ITEMS ON TWO ACHIEVEMENT TESTS GIVEN TO STUDENTS NOT USING DMP IN TWO TYPES OF SCHOOLS (MAY 1972)

School Type/Test	N Items	Beyond Progress	N Items	Unrelated	N Items	Total	Comparative
Urban							
California Achievement	70	.591			70	.591	.805
Cooperative Primary	41	.401	8	.407	49	.402	.500
Nonurban							
California Achievement	43	.797			43	.797	.805
Cooperative Primary	36	.573	8	.513	45	.562	.500
Overall*							
California Achievement		.694				.694	.805
Cooperative Primary		.487		.460		.482	.500

* Unweighted means.

favored the conventional programs. When an analysis was performed that accounted for the progress of instruction in DMP there were no differences between DMP and the conventional programs. By equating test items with DMP objectives, an efficiency ratio could be calculated that compared the student's actual level of learning with his expected level of learning. DMP students performed on a par with their baseline counterparts. All comparisons were made on the basis of the fit of DMP to the standardized tests. No data were available to contrast the achievement of students on those DMP objectives that are not included on standardized tests.

MAINTENANCE OF MASTERY LEVELS

The third field test objective dealt with whether the students could maintain their mastery level on the specific objectives. Data for assessing mastery of the objectives were gathered in the second and third monitoring visits. Students were randomly selected from randomly selected classes. The topic inventory given was appropriate to the objectives taught in the topic completed before the last completed topic. Thus a period of approximately a month elapsed between instruction and this assessment.

This process was hampered in the same way that assessing the mastery of specific objectives was. The relatively slow progress of the classes through the second-grade materials and the absence of regular objectives in the first

topic prevented the gathering of sufficient data from which to generalize. Tests were given for only two topics (Symmetry, Fractions, and Shape; and Representing Joining and Separating Situations). No tests could be given in urban schools. The two topics that were tested were not tested as a part of mastery of specific objectives and hence no direct comparisons can be made between the mastery of objectives and their subsequent maintenance. In subsequent years of the field test more complete data can be gathered.

Table 11 contains the proportion of students who attained the mastery criterion. The same criterion was used for these data as the one for the mastery of specific objectives: receiving a Mastery (M) or Making Progress (P) rating on the objectives of the topic. The data indicate relatively high levels of mastery.

TABLE 11

MEAN PERCENT OF M OR P RATINGS* OF STUDENT PERFORMANCE ONE MONTH OR MORE AFTER INSTRUCTION ON THE OBJECTIVES OF TWO TOPICS

School/Type	Symmetry, Fractions, and Shape	Representing Joining and Separating Situations	Total
Urban			
Nonurban	83	83	83

* Mastery (M) or Making Progress (P) on each objective.

Table 12 contains the percents of each type of rating. These proportions are directly comparable to the figures contained in Table 11. The percents in Table 12 indicate a slight increase in the mastery ratings in the second topic, but this is not an important result since the topics are not in the same content strand.

TABLE 12

MEAN PERCENT OF EACH TYPE OF RATING* OF STUDENT PERFORMANCE ONE MONTH OR MORE AFTER INSTRUCTION ON THE OBJECTIVES OF TWO TOPICS

School/Type		Symmetry, Fractions, and Shape	Representing Joining and Separating Situations	Total
Urban				
	M	37	50	44
Nonurban	P	46	33	39
	N	17	17	17

* Mastery (M), Making Progress (P), Needs Considerable Help (N).

IMPLEMENTATION CONSIDERATIONS

The fourth field test objective deals with implementation information that is important to school personnel. This information concerns program costs, staff responsibilities, time allocation, and material usability. Some of the information reported in this section deals with follow-up data for the first two levels of the program.

Initial implementation costs of the second-grade materials ranged from $6.50 to $10.00 per student, depending on the number of classes that shared the materials kit. Most multiunit schools spent somewhat less per student than conventionally-organized schools. However, in general the initial cost of the second-grade "package" is somewhat more than that for either Level 1 or Level 2 since there is a single materials kit but there are two different workbooks, test booklets, etc. Because of their field test status, the schools themselves actually bore from 40-45 percent of the per-pupil cost (materials kit), while the Center absorbed the remaining amount (the printed materials). Since the materials kit is all-inclusive, containing even such unspecialized items as rubber bands, yardsticks, and yarn, no other expenditures beyond those for ordinary classroom supplies were necessary.

Actual per-student costs for continuing the first two levels of the program ranged from $1.40 to $1.83 and averaged $1.57. These figures included costs for changing versions of teacher materials which will not be necessary when the program is finally implemented. Theoretically the continuing costs (including the costs for the new teacher materials) should be $1.35 per student when calculated on the basis of 32 pupils per classroom. The average actual costs for continuing the program were 16 percent higher than the theoretical costs.

The above figures were the costs for the field test version. The publisher has updated these figures to reflect theoretical commercial costs. Those theoretical costs are reported in Table 13. For comparison purposes the costs of three other mathematics programs are included. The other programs were selected as widely representative of programs that are used by schools. One is a standard text-based program, the second is a popular text-based program that offers a considerable number of enrichment activities and an assessment package, and the third is a combination of innovative programs that is the most comparable to DMP in that it includes a text, an activities package, and an assessment package.

TABLE 13

COMPARABLE PER-STUDENT COSTS OF DMP AND THREE OTHER MATHEMATICS PROGRAMS FOR GRADES K-2

Program	First Year	Continuation	Over Four Years
DMP	9.63	2.16	4.03
*Standard			
Cloth-bound Text	5.05	2.11	2.85
Consumable Text	3.95	3.61	3.70
*Popular	5.90	2.20	3.13
*Combination	8.82	3.79	5.05

* See text for description.

The costs for DMP compare favorably to the programs listed above. Over a four-year period, DMP is slightly more expensive than the consumable version of the standard text series and cheaper than the new program that compares most closely to DMP. The popular textbook series and the cloth-bound version of the standard text series are less expensive than DMP but, even with enrichment activities and an assessment program, they do not offer as complete a program as DMP.

Inservice time, planning time, and the responsibilies of added staff, such as aides, were also considered. Continuing teachers who had received inservice training in the first year of the field test did not require further inservice. They also reported spending somewhat less time preparing for DMP in their second year due to their experience with the program. New teachers were requested to attend a one-day workshop in the fall, bimonthly hour-long meetings for the first semester, and a half-day mid-year workshop. These inservice days were well-attended and well-received. However, it is the Center's judgment that the new teachers required less inservice guidance during the school year than new teachers during the first year of the field test (probably due to the presence of experienced DMP teachers in each building). Also, although the new teachers still found it necessary to spend a considerable amount of time preparing for DMP, in general there were fewer complaints in this area, and it is possible that less time was actually spent, due to program improvements. With the change to workbooks and a comprehensive materials kit, time spent in the previous year duplicating worksheets or searching for materials could be applied to other classroom preparations. Also, the students came to the teachers with a DMP background, a factor that may have eased the teachers' adjustment. Although there was evidence of reductions in additional staff time, DMP cannot be a conventionally-taught program, and a commitment to extensive preparation and inservice time still must be a prerequisite for program adoption.

Where available, teacher aides were again used extensively and were viewed as invaluable. However, as in the first year of the field test, teachers in Chicago successfully used DMP without the benefit of aides. Where aides were employed, they prepared materials, set up stations, assessed students, kept records, and assisted with instruction. No change in the amount of aide time utilized for DMP was noted from the first to the second year, but there were shifts in services performed. Since there were more paper-and-pencil tests available in the second year, some aides participated in more assessment activities. Aides were utilized more for instructional assistance, due very likely to fewer time-consuming duplicating tasks.

Appropriateness, or usability of materials, for students and teachers was examined with particular attention to how changes in the materials were received by continuing teachers. General attitudes of new and continuing students and teachers were also surveyed. Further, specific errors or confusion in the instructional materials were documented and appear in Appendix C; the formative reports were purposely concentrated on the second grade materials, which were in their first year of field testing. All reports were submitted to the developers for consideration of revisions. Except for isolated comments about specific activities, almost all program revisions were warmly received by the continuing teachers. Prominent among the most welcome changes were the addition of all-inclusive materials kits and the new balance beams. The workbooks were generally approved, especially since page perforations made it easy to be flexible in using the workbooks. A minority of teachers continued to express

the feeling that workbooks lead to a lockstep approach and lack of individualization. There was also a fairly continuous request for a separate group of workbook activities, or even a separate workbook, games for the children to play independently, drill-and-practice exercises, etc. Among the major positive modifications in the teacher materials was the new Topic Sequence Chart and the repetition of the objectives throughout the materials for easy reference. Appreciation was expressed for brevity in activity explanations; however, there were still some complaints about "too much verbiage."

Revisions in the assessment component, such as new paper-and-pencil tests and shortened tests, were looked upon favorably. Teachers had difficulty using placement inventory results to group students for instruction in specific objectives or topics. They did, however, find the results informational and useful for general group background and for roughly grouping a large number of students into two or three small groups. There remains a general lack of confidence in these inventories. The record forms were not revised substantially and, as in the first year, teachers chose to use one of the three record cards, usually the Group Record Card. The Topic Checklists were used more and more infrequently; this seems to be directly related to the greater availability of paper-and-pencil tests, especially at Level 3. There was a strong tendency to avoid making formal observations and to simply assess all students on the paper-and-pencil tests.

The new teachers had few negative comments concerning the usability of the second-grade materials, which of course incorporated the revisions in Levels 1 and 2 discussed above. The single outstanding problem came with the first two topics in the series of sentence topics, 3.1 and 3.3. They were exceedingly difficult to pace and were confusing to both teachers and students. When the students could not demonstrate the desired level of mastery, teachers tended to bog down, reinstructing the students in these topics. Further detailed comments appear in Appendix C. Only isolated classes reached Level 4, so usability information is not available.

Teachers, whether new or continuing, were again very dissatisfied with the packaging of all levels of materials kits. They repeatedly suggested that all items be well-labeled and have sturdy containers in which to be organized, stored, and transported.

Perhaps the greatest problem concerning the usability of the program was the students' lack of progress through the program. The slow pace was noticeable during the first field test year but was attributed to the initial problems with the adoption of any new program. During the second year, however, it was increasingly obvious that students were simply moving very slowly through the program. Only two of the twenty-five Grade 2 groups had moved into Level 4 by the end of the year. A variety of factors seem to be responsible. Many groups had not completed Level 2 topics. There were problems with early topics in Level 3 (discussed above). Teachers tended to complete nearly every activity offered even though it was not prescribed in the Teacher's Guide. Whatever the reasons, at that pace the field test students were not likely to complete a reasonable number of DMP levels before the end of elementary school.

In seven of the eight schools, the attitudes of pupils and staff toward DMP were overwhelmingly positive. Much of the positive teacher response to the program seems to be a result of student enjoyment and success at learning DMP--with the exception of the early topics in Level 3. In the school in which the attitude became negative, the major objection was the discrepancy between instruction in DMP and standardized test objectives.

IV

SUMMARY

The continuation of a field test begun in 1971-72 was conducted in the second grade of the same eight schools. Four were multiunit schools located in settings that ranged from small towns to large cities; four were conventionally organized and located in large urban areas. The purposes of the field test were (1) to determine the effectiveness of the instructional program in terms of the achievement of the students, and (2) to document the usability of the program.

The effectiveness of the instructional program was assessed by administering program tests to random samples of students. The testing sessions were conducted during three monitoring visits made to stratified random samples of field test schools. The tests were selected according to one of two criteria: appropriateness for assessing mastery of the most recent instructional objectives, or appropriateness for assessing mastery of those objectives taught just before the most recent instructional unit. These data provided information on the mastery levels of the students and their maintenance of those mastery levels. The effectiveness of the program was also assessed by comparing the results from standardized tests given to DMP students and non-DMP students.

The results of these investigations were generally satisfactory. Approximately 81 percent of the students attained the specified criterion of Mastery (M) or Making Progress (P). This percentage was not uniformly obtained on all objectives; the range was 54 percent to 100 percent. The differences seemed to indicate a need to revise the materials. When students were assessed for maintenance of mastery levels, approximately 83 percent of the students were at the expected level of mastery (Mastery or Making Progress). These effects were not firmly established due to a weakness in the collection of the data.

The results of the comparisons of standardized test scores were mixed. For the multiunit schools there was a noticeable deficiency in the scores of the DMP students, particularly on one of the two tests used. For the urban schools the scores generally favored the DMP students. In an item analysis that accounted for the progress of the DMP students through the program, the achievement level was found to be above the expected national norms for both the urban and nonurban students.

The usability of the program was well documented. The commercial cost was found to be competitive with a range of existing mathematics programs. Although the requirements of additional preparation time and inservice time still existed, there was some evidence of a reduced need through improvements in the materials and familiarity with the program in the second year of the field test. A few of the topics were found to be troublesome to implement, but in general the enthusiasm for the program was sustained through the second year. Finally, it was found that the problem of pacing the students through the program was not due solely to the fact that this was a field test.

This second field test renewed the hopeful note which ended the report of the first field test. Teachers will expend the effort to adapt to the program. Students will master the objectives and they both will be enthusiastic about the endeavor.

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Appendix A

Memoranda of Agreement

MEMORANDUM OF AGREEMENT

between

The Wisconsin Research and Development Center for Cognitive Learning

and

Milwaukee School District

The Wisconsin Research and Development Center for Cognitive Learning (Center) and the Milwaukee School District (District) agree cooperatively to field test during the 1972-73 academic year Levels 2 through 5 of Developing Mathematical Processes (DMP) instructional materials which were developed by the Center. The field test will be conducted at Fourth Street School with all children in their second through fourth years of school and at Victory School with all children in their second and third years of school. The Center agrees to advise its vendor, Rand McNally, to fill orders for materials placed by the school district.

A. The Center will provide at no cost to the District:

1. One day of staff inservice prior to the opening of school and one half-day of staff inservice mid-year. This inservice is designed for teachers new to DMP regardless of grade level. However, continuing teachers are welcome to attend. Participating teachers and aides will be reimbursed at their usual hourly rate for such inservice.

2. All field test materials for teachers and all printed instructional field test materials for children for Levels 3-5. If the district purchases revised activity and test booklets for Levels 1 and 2, the Center will provide all associated printed materials for teachers.

3. Criterion-referenced tests directly associated with the instructional program for Levels 3-5 and tests associated with the gathering of criterion data.

4. Feedback to school systems regarding the field test results in the form of a written report. The initial report will be provided by August 20, 1973, with a more extensive report to follow by December 31, 1973.

5. Feedback and assistance to the staff of the participating school at least twice a semester in the form of a half-day visit by a Center staff person.

6. A non-professional person (aide) for three hours per day to assist the cooperating teachers in Fourth Street School in implementing the program.

B. The District will insure that the participating schools will:

1. Provide the manipulative aids required for program implementation per Center recommendations.

2. Engage all eligible pupils and staff in the participating school(s) in the program, as indicated in Paragraph One of this Memorandum of Agreement.

3. Pay any shipping costs for returning tests to the Center.

4. Devote a minimum of two and one-half hours instructional effort weekly per child to the DMP program.

5. Provide up to two hours of pupil time for the gathering of criterion data yearly; apprise the Center of the schedule and procedures of the local testing program; and share with the Center any intelligence or achievement data from the participating schools gathered throughout the District's testing program.

6. Inform the Center upon Board of School Directors' attention to and approval of any school boundary changes affecting over 10 percent of the enrollment of a given school, so that termination of the test at the affected grade levels can be jointly considered.

C. It is furthermore understood that the 1972-73 school year is the second year of the DMP field test, and that the Center and school anticipate continuation of the test in at least the 1973-74 school year and for children in their fifth and sixth years of school, should both parties agree that the second year of the test is successful.

Agreed to:

William R. Bush, Deputy Director
Wisconsin Research and Development
Center for Cognitive Learning

(Date)

Agreed to:

(Signed)

(Title)

(District)

(Date)

MEMORANDUM OF AGREEMENT

between

The Wisconsin Research and Development Center for Cognitive Learning

and

The Chicago Public Schools

The Wisconsin Research and Development Center for Cognitive Learning (Center) and the Chicago Public Schools (District) agree cooperatively to field test during the 1972-73 academic year Levels 2 through 5 of Developing Mathematical Processes (DMP) which were developed by the Center. The field test will be conducted in Parkman and Hamline School(s) with all children in their second through fourth years of school and in Willard School with children in their second and third years of school. The Center agrees to advise its vendor, Rand McNally, to fill orders for materials placed by the school district.

A. The Center will provide at no cost to the District:

1. One day of staff inservice prior to the opening of school and one half-day of inservice mid-year. This inservice is designed for teachers new to DMP regardless of grade level. However, continuing teachers are welcome to attend.

2. All field test materials for teachers and all printed instructional field test materials for children for Levels 3-5. If the district purchases revised activity and test booklets for Levels 1 and 2, the Center will provide all associated printed materials for teachers.

3. Criterion-referenced tests directly associated with the instructional program for Levels 3-5 and tests associated with the gathering of criterion data.

4. Feedback to school systems regarding the field test results in the form of a written report. The initial report will be provided by August 20, 1973, with a more extensive report to follow by December 31, 1973.

5. A professional part-time (40%) person to assist the cooperating teachers in implementing the program.

6. Feedback and assistance to the cooperating staff of each school in the form of a visit at least twice a month. Ordinarily this visit will be made by the person provided under A.5.

B. The District will insure that the participating school(s) will:

1. Provide the manipulative aids required for program implementation per Center recommendations.

2. Engage all eligible second through fourth year pupils and staff in the participating school(s) in the program.

3. Pay any shipping costs for returning tests to the Center.

4. Devote a minimum of two and one-half hours instructional effort weekly per child to the DMP program.

5. Provide up to two hours of pupil time for the gathering of criterion data yearly; apprise the Center of the schedule and procedures of the local testing program; and share with the Center any intelligence or achievement data from the participating schools gathered throughout the District's testing program.

6. Inform the Center in advance of school boundary changes affecting over 10% of the enrollment of a given school, so that termination of the test at the affected grade levels can be jointly considered.

C. It is furthermore understood that the 1972-73 school year is the second year of the DMP field test, and that the Center and District anticipate continuation of the field test in at least the 1973-74 school year and at Grades 4 and 5, should both parties agree that the second year of the test is successful.

Agreed to:

William R. Bush, Deputy Director
Wisconsin Research and Development
Center for Cognitive Learning

(Date)

Agreed to:

(Signed)

(Title)

(District)

(Date)

MEMORANDUM OF AGREEMENT

between

The Wisconsin Research and Development Center for Cognitive Learning

and

Green Bay, Gale-Ettrick-Trempealeau, Sparta Area Public Schools

The Wisconsin Research and Development Center for Cognitive Learning (Center) and the _____ (District) agree cooperatively to field test during the 1972-73 academic year Levels 2 through 5 of Developing Mathematical Processes (DMP) which were developed by the Center. The field test will be conducted in _____ _____ School(s) with all children in their second through fourth years in school. The Center agrees to advise its vendor, Rand McNally, to fill orders for materials placed by the school district.

A. The Center will provide at no cost to the District:

1. One day of staff inservice prior to the opening of school and one half-day of inservice mid-year. This inservice is designed for teachers new to DMP regardless of grade level. However, continuing teachers are welcome to attend.

2. All field test materials for teachers and all printed instructional field test materials for children for Levels 2-5. If the district purchases revised activity and test booklets for Levels 1 and 2, the Center will provide all associated printed materials for teachers.

3. Criterion-referenced tests directly associated with the instructional program for Levels 2-5 and tests associated with the gathering of criterion data.

4. Feedback to school systems regarding the field test results in the form of a written report. The initial report will be provided by August 20, 1973, with a more extensive report to follow by December 31, 1973.

5. Feedback and assistance to the staff of the participating school at least twice a semester in the form of a half-day visit by a Center staff person.

B. The District will insure that the participating school(s) will:

1. Provide the manipulative aids required for program implementation per Center recommendations.

2. Engage all eligible second-fourth year pupils and staff in the participating school(s) in the program.

3. Pay any shipping costs for returning tests to the Center.

4. Devote a minimum of two and one-half hours instructional effort weekly per child to the DMP program.

5. Provide up to two hours of pupil time for the gathering of criterion data yearly; apprise the Center of the schedule and procedures of the local testing program; and share with the Center any intelligence or achievement data from the participating schools gathered throughout the District's testing program.

6. Inform the Center in advance of school boundary changes affecting over 10% of the enrollment of a given school, so that termination of the test at the affected grade levels can be jointly considered.

C. It is furthermore understood that the 1972-73 school year is the second year of the DMP field test, and that the Center and District anticipate continuation of the field test in at least the 1973-74 school year and at Grades 4-5, should both parties agree that the second year of the test is successful.

Agreed to:

William R. Bush, Deputy Director
Wisconsin Research and Development
Center for Cognitive Learning

(Date)

Agreed to:

(Signed)

(Title)

(District)

(Date)

Appendix B

Interview Forms

Monitoring Guide
DMP

PRINCIPAL

1. What costs were involved in continuing DMP in K-1?

2. What is your opinion of the reaction of the teachers, pupils, and parents to DMP?

3. Have you noticed any differences in the teaching approach of the teachers using DMP?

2nd GRADE TEACHER

1. Have you had problems using DMP this year? (problems with materials, directions for teachers, recommended teaching processes)

2. Have you noticed any advantage to using DMP this year? (enthusiasm of students, more learning, transfer principles to other subjects)

3. Do you use the assessment materials? (Placement Inventory, Observation, Topic Inventory, Checklists, Individual Progress Sheets) If so, are they useful? Any problems? (time, ease of administration) If not, how do you evaluate the children in DMP?

4. If the Topic Checklist is used, make a judgment of a proportion of mastery/progressing/non-mastery for each objective instructed this year.

5. Did you confer or receive information from last year's teacher regarding the student's progress in DMP? If so what and how did you use it? (Look for starting up where they left off, or using a Placement Inventory, or teacher judgment.)

6. Do you have groups of students working on different topics at the same time? _____ Do you have groups of students working at different levels within a topic at the same time? _____ How do you form instructional groups?

Would you do more grouping of different varieties if you could? _____
If yes, what prevents you?

K OR FIRST GPADE TEACHER

1. What is your reaction to the revised DMP materials? (improved, about the same, worse; effect on teaching)

2. Is your use of DMP any different this year? (Try to sift out one year's experience if possible; i.e., compare fall 1972 to last winter or spring.)

3. Are you using the assessment materials? Any problems? Are they useful?

4. Are you grouping more this year than last year? How are you effecting it? Would you do more if you could? If yes, what prevents you?

DMP INTERVIEW--SAMPLE 2

Name _____ School _____

Position _____ Interviewer _____

Note to Interviewer: If the person sampled was also drawn in Sample 1, some of these questions will be repetitive. Just explain that they should give their current response to the question; this is how "sampling" works.

PRINCIPAL (omit this section at Morgan Martin and Parkman)

1. What costs other than Rand printed materials were necessary for you to continue DMP at K-1? (e.g., more manipulatives, replacement of broken items, etc.)

2. What is the reaction to DMP of

   teachers?

   pupils?

   parents?

Any special effort made to inform parents about DMP?

3. Is there any difference this year in the attitudes of teachers (pupils, parents) who were involved in DMP last year?

4. What effect, if any, on the teaching approach of teachers does DMP have?

2nd GRADE TEACHER

1. Have you had problems using DMP this year? (problems with teacher or student materials, directions for teachers, recommended teaching processes)

2. Did you teach DMP last year? Yes _____ No _____

   Have you noticed any advantage to using DMP this year? (enthusiasm of students, more learning, transfer principles to other subjects)

3. Which, if any, of the assessment materials do you use? (Placement Inventory, Observation Schedule, Topic Inventory, Topic Checklists, Individual Progress Sheets, Group Record Cards) If so, are they useful? Any problems? (time, ease of administration) If not, how do you evaluate the children in DMP?

4. If the Topic Checklists or Group Record Cards are used, make a judgment of a proportion of your DMP students attaining mastery/progressing/non-mastery for each objective instructed this year (e.g., 20% M, 80% P, 0% N).

5. If you gave a Placement Inventory, what use did you make of the results (e.g., used them as general background information but not to group; used them to form groups; did not group but used information to omit or include certain objectives)?

6. Do you have groups of students working on different topics at the same time? _____ Do you have groups of students working at different activities within a topic at the same time? _____ How do you form instructional groups? What size are the groups typically?

Is any use made of the Instructional Programming ideas in your Guide? Specify:

Would you do more group of different varieties if you could? _____
If yes, what prevents you?

7. Did you confer or receive information from last year's teacher regarding the student's progress in DMP? If so what and how did you use it? (Look for starting up where they left off, or using a Placement Inventory, or teacher judgment.)

TEACHER WHO USED DMP LAST YEAR

1. What is your reaction to the revised DMP materials? (improved, about the same, worse; effect on teaching) Specify what you like and dislike--format, workbooks, etc.

2. Is your use of DMP any different this year, e.g., teaching style, questioning techniques, use of small groups? (Try to sift out one year's experience if possible; i.e., compare fall 1972 to last winter.)

3. Do you feel your attitude toward DMP is any different this year? How?

4. Are you using the assessment materials? (See question #3 for 2nd Grade Teacher.) Any problems? Are they useful?

5. Are you grouping more this year than last year? How are you effecting it? Would you do more if you could? If yes, what prevents you?

6. What procedures have you developed for reporting pupil progress to parents (e.g., convert M, P, N to grades; show parents Topic Checklists; write up a narrative; use a standard report card checklist)?

REMINDER: COLLECT COMMENT CARDS!

Appendix C

Formative Comments

As usual, the comments documented here are reported at "face value." Although a few comments regarding assessment materials are included, these were generally sent directly on to the project staff along with topic inventory response data. Unless specified, the comments about a particular activity were offered by a single teacher; however, most comments of a general nature (e.g., about an entire level or topic) came from unit leaders in multiunit schools and thus can be considered representative of the viewpoint of several teachers.

Level 3

General Comments

Need more work on zeros in sentence-writing topics.
Recommend more use of counters with overhead projector.
Some confusion between empty set and shaded set (format).
Develop an extra booklet (e.g., Part IV) of independent activities, mixing review, "drill," etc.
Offer more variation in activity choices with regard to achievement, so pace for individual students can be more varied.

Topics 3.1 and 3.3--Combine them into one topic.

Students have a great tendency to equalize rather than join (separate). For example, in a problem in which a child has one balloon, then gives one away, he writes 1 + □ = 1.

Why not have both vertical and horizontal formats? (Or, explain somewhere that vertical format is "saved" in DMP for computation.)

Topic 3.3--Moves from objects to symbols too fast. Number stories too complex. Students still confusing addition and subtraction.

Students should draw more pictures.
Too many different worksheet formats.
Topic too sophisticated, complex.
Not enough isolated, concentrated work on each sentence type.
Make objectives preparatory.

Activity 3.3.9a-c--Story problems

Wording causes confusion as do questions asking for irrelevant answers. Since this is early in equalization work, have the irrelevant information questions in the latter problems. Would prefer those in workbook form so students can read along.

Activity 3.3.10--Too long and complicated.

Activity 3.4.5, 3.4.7--Suggest answers for the teachers for the cards.

Teachers feel they have to figure out the station answers ahead of time.

Topic 3.5

Activity 3.5.8, workbook pages 107-8

Not nearly enough worksheets in this format. Not enough work on the unknown in the first position--very troublesome.

Topic Inventory 3.5

The problems annotated for activity 3.5.8 cause difficulties in the Topic Inventory, since it uses this format.

Topic Inventories 3.3, 3.5, 3.7

Don't correspond completely to topic formats.

Activity 3.7.2

Vertical format should be introduced earlier. Would it be OK to tell students $4 + 4 = +_{4}^{4}$?

Activity 3.7.5, workbook page 138

Warn teachers that no half-circle piece is available.

Level 2

General Comment--The 1972-73 revision has less work on equalizing--need more.

Topic 2.6

Too many activities required. Make activities more "to the point."

Level 1

1.6.2B

An inner city teacher reported the "pirate" context was beyond her students' experience. Story 1.6.2 was a great success on the other hand.

1.8.8, workbook pages 67-68, 69--See attached. These comments were offered independently by teachers at two schools.

P. 67-68 are confusing because there are so many different things on the page.

Topic Inventory 1.8

Complaint that one "has to be a magician, using sleight of hand" to give this.

1.10.5, workbook pages 93, 94--See attached.

Generally poorly designed.

Other--Record forms

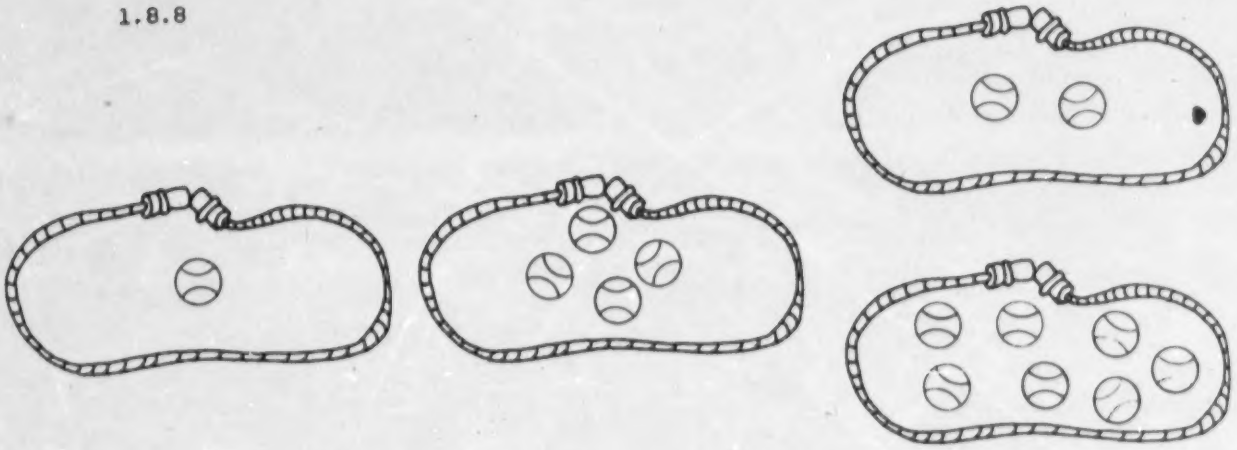
Suggest that they be orderable separately or be packaged originally in larger quantities since they are consumable.

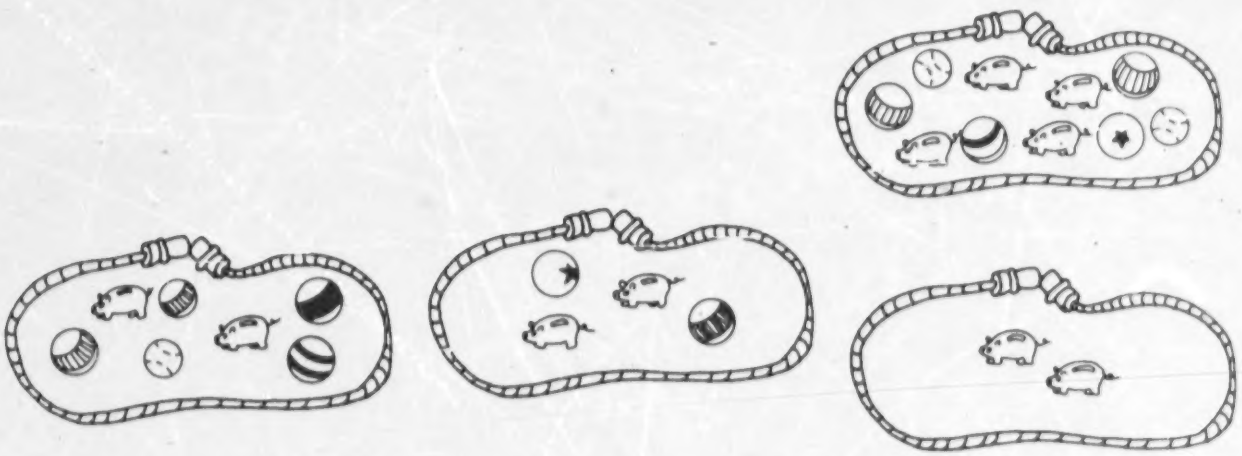
Should indicate on order blank or in publications the quantity of records (and number of students accommodated) that will be sent with printed materials.

Levels 1-2

- Individual assessments still too time-consuming.

1.8.8



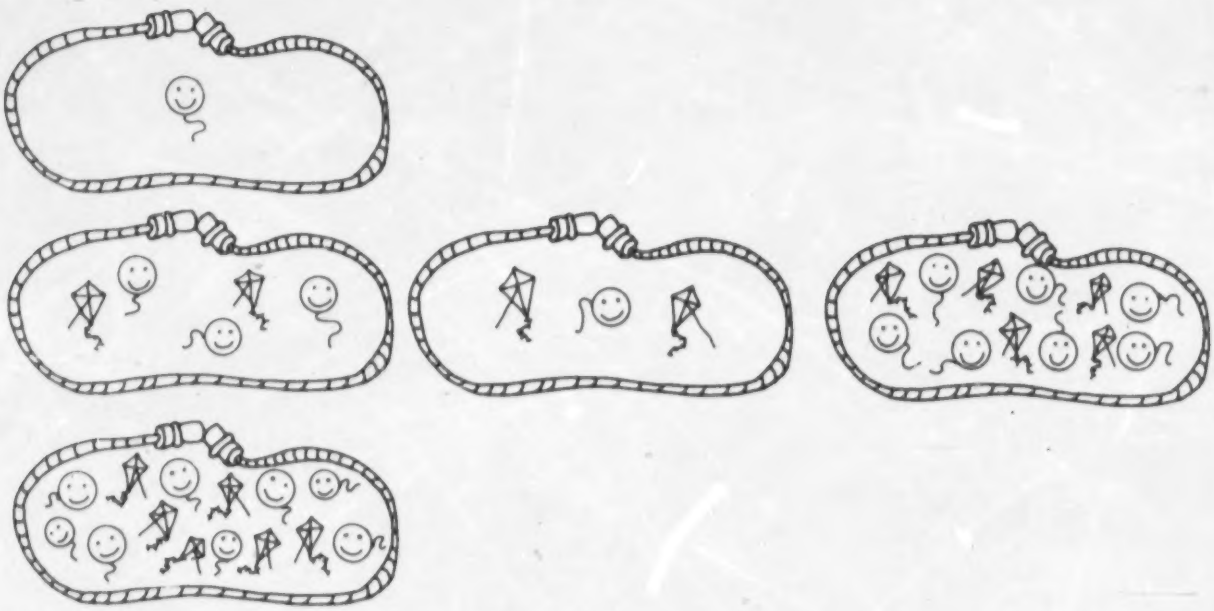


P. 69 is better but all are too detailed, distracting

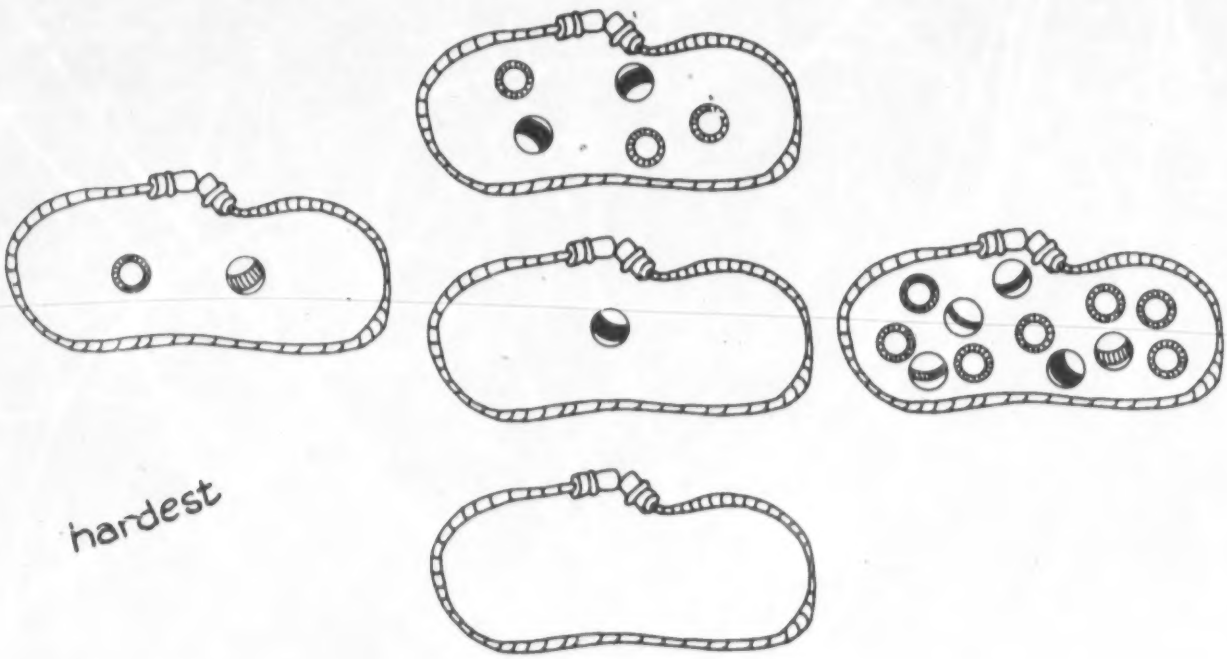
hard, also

(VICTORY)

1.8.8



choice in first position
is too difficult & confusing



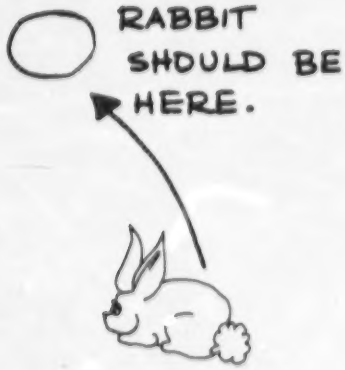
hardest

BEE SHOULD BE HERE WITH LARGER PICTURES.

VICTORY SCHOOL
MAY 1973

1.10.5

1. THE DISTANCE BETWEEN CARROT AND RABBITS IS TOO SIMILAR ($\frac{1}{8}$ INCH).
2. USING STRING AS DIRECTED IS IMPOSSIBLE IN MOST CASES. WE USED STICKY TAPE AND EVEN THAT WAS DIFFICULT.
3. THE KINDERGARTEN CHILD'S COORDINATION IS NOT SUFFICIENTLY DEVELOPED TO HANDLE THIS. THE PICTURES ARE TOO SMALL.
4. THE DIRECTIONS ARE INACCURATE AS YOU CANNOT PASTE THE STRING ON THE OTHER SIDE.



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